Running title: Shanghai Covid lockdown and depression

Rapid increase in depression within the first month of the Shanghai Covid lockdown in 2022

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ABSTRACT

In the global efforts to combat Covid-19, researchers have increasingly recognized the profound impacts of society lockdown on population mental health. However, the fine temporal evolution of negative psychological consequences induced by lockdowns remains poorly understood. Here we report a rapid and systematic increase in depression due to the Shanghai Covid lockdown during March 2022. Measured by Beck Depression Inventory-2, 10% of the participants experienced at least mild depression before the official citywide lockdown started, and two and four weeks later this number increased to 21% and 36 %, respectively. Regression analyses show that lockdown duration and physical restriction jointly contribute to worsening depression. Furthermore, the time of sleep and social communication during the lockdown are associated with the severity of depression symptoms. These results highlight the fast development of depression during lockdowns and call for special attention to early psychological interventions once a lockdown is initiated.

Keywords: Covid-19, Depression, Lockdown, Shanghai, Omicron

INTRODUCTION

Covid-19 has become a global health crisis and severely threatened healthcare systems in many countries. To prevent further spread of the virus, many governments have to impose strict social isolation or society lockdowns. Despite its efficacy in blocking virus transmission, lockdowns also produce a broad range of secondary social, economic, and psychological consequences. Besides the socio-economic problems such as economic recession and heightened unemployment rate, mental health problems induced by lockdowns are perhaps the most prominent secondary health issues that every country must face[1]. The sudden and drastic changes in people's daily lives, such as remote work or unemployment, travel restriction, and reduced leisure activities remarkably challenge people's psychological resilience[2]. Such psychological pressure can spread widely. The world first Covid lockdown in city Wuhan in January 2020 affected the mood status of doctors in Shanghai's hospitals who were hundreds of miles away[3], a fact highlighting the unexpected effects of lockdowns.

Although the stringency of lockdown varies across countries, existing studies have reached a consensus that lockdowns can cause profound negative psychological consequences in population. Covid lockdowns have been shown to disrupt mental health in countries as varied as China[4], Italy[5], Germany[6] _ENREF_6, Switzerland[7], United Kingdom[8], etc. These negative effects are also reported in different populations, such as child and adolescent[9], doctors[3] and nurses[10], and college students[11]. A systematic meta-analysis performed in 2020 showed that the pandemic induces a 32% prevalence of anxiety and a 27% prevalence of depression, respectively[12]. The converging evidence substantiates the alarming prevalence and severity of mental health issues associated with Covid lockdowns.

Previous endeavors investigating the mental health issues generally fall into two categories. First, several studies used cross-sectional design where mood status of participants during lockdowns and those who are not in lockdowns are assessed and compared. For example. Sameer and colleague[13] surveyed the coping strategies of 418 subjects from 18 distinctive countries, and found that people in developing countries—India and Pakistan had severer depression. Second, a few studies used a longitudinal design, which is theoretically more convincing, to examine the dynamic changes of mood status as the pandemic or lockdowns continue. Those studies typically contrasted the epidemiological data collected during and before a lockdown. For example, Banks et al.[14] used the longitudinal micro data for the UK over the

period 2009-2020 and found that Covid-19 not only confers a general negative impact on mental health but also enlarges economic inequities across population. These findings are valuable but usually provide evidence at the temporal scale of years or months. It remains unclear the fine temporal evolution of mental health diseases, such depression, in days or weeks during lockdowns. As early prevention and intervention are paramountly important to alleviate mental health pressures, investigations of the development of depressive symptoms during the early phase of lockdowns are of particular value to psychiatrist, epidemiologists, and policymakers.

As the largest city in China with 25 million residents, Shanghai has witnessed a wave of epidemic in Spring 2022. By May 4, the cumulative number of infected cases exceeds 535 thousands. As confirmed cases increased rapidly in March, the Shanghai government initially implemented sporadic lockdowns and soon extended the lockdown to the whole city on April 1, 2022. We assessed depressive symptoms in Shanghai residents at early March, late March, and early April in order to quantify the dynamic changes of depression severity as the citywide lockdown was gradually enforced. Our study may sheds a new light on the fine temporal development of depression during a lockdown.

METHODS AND MATERIALS

Participants

All Shanghai residents aged 18 years or older are eligible to participate in the questionnaire. We released our online survey on April 15, 2022. 657 volunteers participated in our study between April 15 and 17, 2022, and a total of 652 participants (212 males) completed the survey. The age of the participants ranges from 18 to 82 (see detailed demographics summary in Table 1). Due to the web-based design, it is infeasible to calculate the true response rate because we cannot estimate the total number of people who were reached by our social network advertising.

Online survey

The survey was powered by www.wjx.cn. All data are kept strictly confidential. The online survey was administered between April 15 to 17, 2022. Importantly, we defined three distinct periods with respect to the Shanghai Covid lockdown: the first half of March (*period 1*) when residential lockdown sporadically occurred in Shanghai, the second half of March (*period 2*) when the majority of Shanghai was in lockdown, and the first half of April when the whole

Shanghai was in strict lockdown. The whole online survey encompasses two classes of questions: socio-demographic and health-related questions, and the Beck Depression Inventory-2 (BDI-2).

Socio-demographic and health-related questions. The socio-demographic part includes three questions each for age, gender, and occupation. We also ask whether the participants encountered different levels of activity restriction and whether they lived alone during the three periods. Furthermore, the survey includes five questions with respect to the duration of online shopping, work, physical exercise, sleep, and social communications, respectively, during the three periods. To assess the impact of the lockdowns on physical conditions, the participants self-reported the bodyweight change in the three periods. We also include two optional open-ended questions asking what were the most desirable things and what did they mostly worry about during the three periods.

In addition, we also ask whether they were non/confirmed/close contact/secondary contact or rehabilitated cases of Covid-19 during the three periods, and how many doses of Covid-19 vaccines they had taken. To further examine the history of depression, two questions are included to examine whether the participants have been previously diagnosed as depression (yes/no), and if yes, whether they are taking medicine (yes/no).

The online survey contains a total of 17 socio-demographic and health-related questions.

*Beck Depression Inventory-2 (BDI-2)***.** The characteristic attitudes and symptoms of depression in all participants were evaluated by the validated 21-item Beck Depression Inventory-2 (BDI-2)[15]. Each item is a 4-point scale arranged in increasing the severity of a particular symptom of depression. For example, participants can report 0 to 3, where 0 denotes "I do not feel sad" and 3 denotes "I am so sad and unhappy that I cannot bear it". The total score of a participant should span from 0 to 63. Based on the total score, a participant can be classified into four categories: normal (<=13), mild depression (14-19), moderate depression (20-28), and major depression (29-63).

In summary, our online survey contains a total of 38 questions (17 socio-demographic and health-related questions, and 21 BDI-2 questions).

Table 1. Descriptive statistics of socio-demographic and other auxiliary questions.

Characteristic	Person, No. (%)	BDI-2 scores (median; IQR)		
		Period 1	Period 2	Period 3
Total	652 (100%)	1; 6	5; 10	9; 13
Gender				
Men	212 (32.5%)	1; 5	4; 9	8; 11.75
Women	440 (67.5%)	1; 6	5; 10	9; 14
Age (years)				
[18,30)	96 (14.7%)	2; 6	7; 10.75	10; 15
[30,40)	233 (35.7%)	1; 6	5; 10	9; 14
[40,50)	172 (26.3%)	1; 6	4; 9	9; 13
[50,60)	95 (14.6%)	1; 5	3; 7	7; 11
More than 60	56 (8.6%)	4; 7	5; 11.25	7; 12.75
Profession				
Employees	285 (43.7%)	1; 5	5; 11	10; 14
Professionals	187 (28.7%)	1; 5	4; 8	8; 10
Retirees	71 (10.9%)	3; 7	4; 9	7; 11
Unemployed	12 (1.8%)	2.5; 22.5	3.5; 26.5	3.5; 27
Students	39 (6.0%)	2; 9	9; 9	10; 15
Freelancers	58 (8.9%)	1.5; 5	5; 9.25	9.5; 16.25
Diagnosed with depression?				
Yes	18 (2.8%)	4; 25.75	13.5; 28.25	24; 23.5
No	634 (97.2%)	1; 5.25	4; 10	8; 13
Vaccination coverage				
Only one dose	26 (4.0%)	1; 5.25	4; 9.25	10; 10.25
With one booster dose	194 (29.8%)	1; 6	6; 10	10; 14
With two booster dose	362 (55.5%)	1; 5	4; 9	7; 12
Unvaccinated	65 (10.0%)	3; 6	6; 10.5	10; 15.5
Living situation				
Alone	92 (14.1%)	2; 7	4.5; 7.25	8; 14.75
Not alone	560 (85.9%)	1; 6	5; 10	9; 13

Statistical analyses

Frequency analyses were performed in order to ascertain the prevalence of each outcome, A generalized linear regression and a random forest regression were applied in order to explore the impact of the proposed predictors and their interaction on the selected outcomes. Due to skewed distributions of BDI-2 scores, we log-transformed the BDI-2 scores before further analyses. Unless noted otherwise, all ANOVA, t-tests, and regression analyses were performed on log-

transformed BDI-2 scores. Because of the low missing data rates (<1%), missing data were treated with listwise deletions in regression analysis. Relevant data analyses were performed using R.

To analyze the two open-ended questions, we tokenized the sentences using the Stanford CoreNLP python package and categorized the participants' desired activity into 11 different topics. Calculation on the tokenized word frequency was utilized to analyze residents' desire change over lockdown periods.

RESULTS

Rapid increase in depression within the first month of the Shanghai Covid lockdown

We collected a total of 652 valid samples after excluding samples with missing values (<1%). All descriptive statistics of socio-demographic information and other auxiliary questions are summarized in Table 1. Here, we asked all participants to answer the questions with regard to the three distinct phases of the Shanghai Covid lockdown (see methods for details)—early March (period 1), late Marth (period 2), and early April (period 3). We observed a significant increase in the overall restriction of physical activity from 45.4% in period 1 to 94.5% in period 3. This is consistent with the fact the Shanghai government imposed increasingly stringent lockdown policies as the Covid-19 confirmed cases rose rapidly during March 2022.

We performed a one-way repeated measure ANOVA with the log-transformed BDI-2 scores as the dependent variable, and lockdown period (1/2/3) as the with-subject variable. We found the significant main effect of lockdown period ($F_{2, 1302} = 479.813$, $p < 0.001$, partial $\eta^2 = 0.424$), indicating a clear rising trend of depression as the lockdown proceeded. Post-hoc analyses reveal that even the first two weeks of the lockdown drastically elevated the BDI-2 scores from period 1 (median = 2; IQR = 6) to period 2 (median = 2; IQR = 6; period 1 vs. 2, paired t-test, $t_{651} = 18.839$, $p < 0.001$, Cohen's d = 0.544, Bonferroni-corrected). The lockdown continued to worsen depression from period 2 to period 3 (median = 10, IQR = 13; period 2 vs. 3, paired t-test, $t_{651} = 16.449$; $p < 0.001$, Cohen's d = 0.437, Bonferroni-corrected). We further plotted the raw BDI-2 score distributions of the three periods, and observed a clear shift of whole distributions from period 1 to period 3 (Wilcoxon matched-pairs signed-ranks test, period 1 vs. 2, $p < 0.001$; period 2 vs. 3, $p < 0.001$; Fig. 1A).

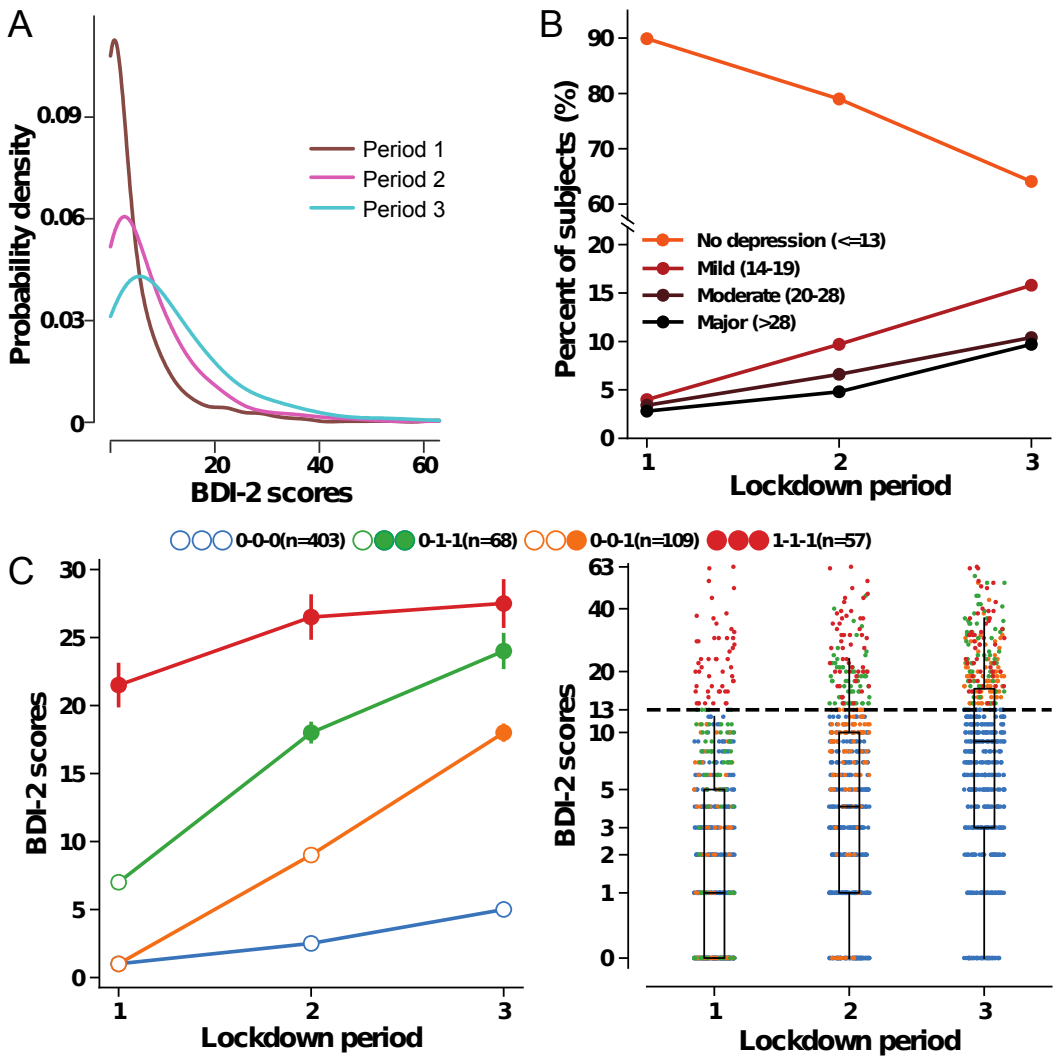

Figure 1. Increased severity of depression induced by the prolonged lockdown**.** ***A*****.** the distributions of BDI-2 scores of all participants at the three lockdown periods. ***B***. the changing trend of the percentages of the participants without depression (BDI-2 scores<=13) and those with mild (14-19), moderate (20-28), and major depression (>28), respectively. ***C***. the median BDI-2 scores of the eight subgroups of the participants categorized by whether their scores were above 13 (1/0) at the three lockdown periods. For example, the group "0-1-1" represents the participants whose scores were initially low (<=13) in period 1 but increased to be larger than 13 in period 2 and 3. Note that the number of participants in the group "0-1-0" (N=6), "1-0-0" (N=3), and "1-1-0" (N=6) were very low. No participants were found in the group of "1-0-1". ***D***. Box plots of BDI-2 scores of all participants at the three periods. We further plot the scatter points of individual participants of the four subgroups in the subplot ***C***.

According to the categorization criteria in BDI-2, we classified all participants into two subgroups—participants with (BDI-2 scores >13) and those without depression (<=13). We

found that the portion of participants with depression started at 10.1% in period 1 and increased to 21% during period 2, and further to 35.9% during period 3 ($\chi^2(1, N=1294)$, $p < 0.001$). We further divided the depressive participants into three sub-groups with increasing severity—mild (14-19), moderate (20-28), and major depression (>28). We observed that the percentage of all three sub-groups increased ($\chi^2(6, N=1956)$, $p < 0.001$) from period 1 to 3 (Fig. 1B).

We validated our results by using different criteria to categorize participants. A participant who was initially non-depressive may later on turn into depression, and vice versa. Theoretically, we can divide all participants into eight sub-groups based on whether one was depressive (BDI-2 score > 13) or not (<=13) at the three periods. For example, the participants who were initially non-depressive in period 1 but became depressive in period 2 and 3 are coded as the "0-1-1" group. We observed increased BDI-2 scores in the majority of participants (Fig. 1C). The numbers of participants belonging to the four groups whose depression severity fluctuated and declined (e.g., "1-0-0") were very small (N = 15, 2.3%). Interestingly, even the participants whose BDI-2 scores did not exceed 13 in all three periods also experienced severer depression symptoms as the lockdown duration increased (one-way repeated ANOVA, $F_{2,415} = 271.236$, $p < 0.001$, partial $\eta^2 = 0.395$).

Taken together, all results above strongly support the hypothesis that acute social isolation and society lockdowns can induce a rapid and dramatic increase in depression even in the first few days of a lockdown.

Social, psychological, and physical factors associated with depressive symptoms

We performed three ANOVAs to examine the influences of lockdown period and restriction condition on depressive symptoms. In each ANOVA, the log-transformed BDI-2 scores were set as the dependent variable, with the lockdown period (1/2/3) as the within-subject variable, restriction condition (yes/no) at each period as the between-subject variable. Age and gender were included as covariates. In all three ANOVAs, we found the main effects of lockdown period (all p values < 0.001) and restriction condition (all p values < 0.001). We also found a significant interaction between the two variables in the ANOVA with restriction condition in period 1 as the between-subject variable (see Supplementary Note 1 for the full statistical results). The BDI-2 scores of all participants across lockdown periods and restriction conditions are plotted in Fig. 2A. To investigate the interaction effect, we performed three t-tests to examine

the differences between restriction conditions at each lockdown period. Results revealed significantly higher BDI-2 scores in participants in the lockdown as compared to those without any restriction (all $p < 0.001$, Bonferroni corrected, see Supplementary Note 1 for full statistical results). Taken together, these results suggest that lockdown period and physical restriction strongly influence depressive symptoms.

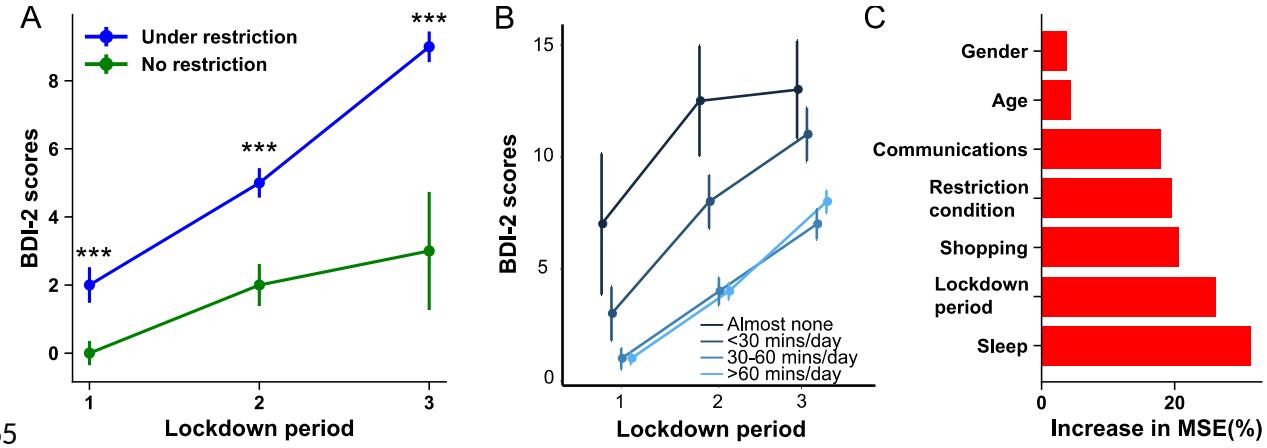

Figure 2. Various factors associated with depressive symptoms during the lockdown. ***A***. Interaction effect of lockdown period and restriction condition. Physical restriction engenders a stronger difference in period 3. Error bars are standard errors across participants (***: $p < 0.001$). ***B***. the moderation effect of communication duration per day on the influences of lockdown period on depressive symptoms. Error bars are standard errors across subjects. ***C***. Factor contributions as measured by increases in mean squared error (%) in the random forest regression. Lockdown period and sleep time are the top 2 contributors to depressive symptoms.

To further explore the potential predictors of depressive symptoms, we performed a multivariate linear regression analysis with the log-transformed BDI-2 scores as the dependent variable, and lockdown period, restriction condition, and the durations of sleep/shopping/social communication per day as predictors. According to the results above, the interaction term of lockdown period and restriction condition was also included as a predictor. Age and gender were included as covariates. The statistical summary of the regression analysis is shown in Table 2. Critically, the significant contributions of lockdown period ($\beta = 0.096$, $p = 0.002$) and the interaction of lockdown period and restriction condition ($\beta = 0.074$, $p = 0.032$) are consistent with the ANOVA results above. Interestingly, the duration of online shopping ($\beta = -0.058$, $p < 0.001$) per day positively predicts the BDI-2 scores, reflecting people's worry on supplies shortage. In contrast, the durations of communication ($\beta = -0.091$, $p < 0.001$) and sleep ($\beta = -0.115$, $p < 0.001$) per day were negatively correlated with BDI-2 scores. Here, sleep time, which

is in theory unrelated to the lockdown, was also significantly shortened, acting as a risk factor for depression and anxiety.

Table 2. Summary statistics of the multivariate linear regression analysis

Factors	Beta coefficient	Std. Error	*p* value
Lockdown Period	0.096	0.031	0.002**
Restriction Condition	0.009	0.059	0.878
Lockdown x Restriction	0.074	0.035	0.032*
Communication	-0.091	0.011	<0.001***
Shopping	0.058	0.006	<0.001***
Sleep	-0.115	0.015	<0.001***
Age	-0.001	0.001	0.654
Gender	-0.036	0.021	0.090

The significance conventions are *: < 0.05; **:<0.01; ***:<0.001.

The associations between the severity of depressive symptoms and sleep, shopping, and communication time also prompt us to explore the moderation effects of these factors. We found that the communication duration per day moderates the influences of lockdown period on depressive symptoms (Fig. 2B).

The statistical contributions of different factors to BDI-2 scores were further evaluated by a random forest regression analysis. Amongst the nine predictors, lockdown period and sleep time act as the top 2 contribute to the BDI-2 scores (Fig. 2C).

Emotional status revealed by natural language processing analyses

Our survey includes two optional and open-ended questions where the participants can freely express their emotions and attitudes. The two questions are “what were your most desirable things?” and “what did you mostly worry about?”. The participants could answer these two questions with respect to the three lockdown periods. Interestingly, we found that 165, 181, and 255 participants responded for the three lockdown periods, respectively, indicating a stronger willingness to express their emotions during the lockdown. We observed a clear increase in the desire for physical freedom and normal life, as well as food. It should be noted that food shortage is a major problem under Shanghai’s stringent lockdown policy hence residents are struggling for food supply every single day. The craving for travel, rest, entertainment declined over time, possibly due to adaptation to the lockdown life.

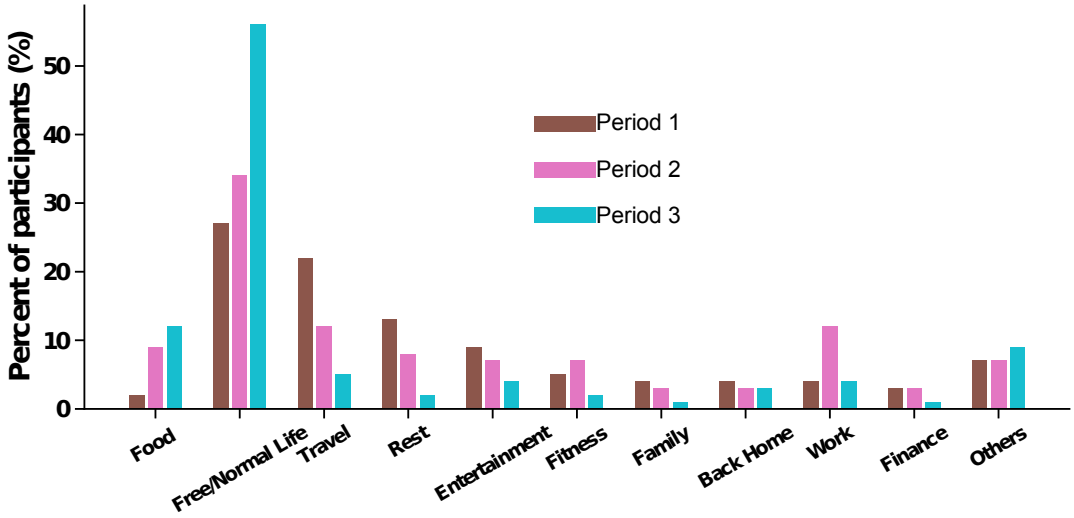

Figure 3. Topic frequency in the two open-ended questions. In our survey, we included two open-ended questions: (1) *"what were your most desirable things?"* and (2) *"what did you mostly worry about?"*. The participants answered the two questions with regard to the three lockdown periods, respectively. The percent of participants who mentioned each topic are plotted.

DISCUSSION

The influences of Covid lockdowns on mental health are remarkable. The central aim of our study is to uncover the fine temporal development of depression induced by a citywide lockdown. In the context of the Shanghai Covid lockdown in Spring 2022, we used BDI-2 to assess Shanghai residents' depressive symptoms in early March, late March, and early April, the three distinct phases during which the lockdown was gradually expanded to the whole city. In addition, we collected several socio-demographic and health-related questions, and established statistical models to explore their influences on depression. We obtained several important findings. First, our results show a rapid and dramatic increase even within the first two weeks of the lockdown, and the situation worsened two weeks later. Second, lockdown duration and physical restriction significantly affect depression progression. Third, the duration of sleep, shopping, and communication were associated with depressive symptoms. These results highlight the rapid progression of depression within the first few weeks once a lockdown is initiated, and point out the need for early psychological interventions to alleviate the negative consequences.

Our study is of particular value for mental health practitioners to understand the impact of lockdown on mental health. Although the negative psychological consequences have been widely reported in several countries and populations, it remains unclear how quickly depression would arise during a lockdown. The majority of previous studies contrasted the depression level during lockdowns and that measured in months or years ago before the pandemic. As modern psychiatry increasingly emphasizes early prevention and interventions on depression, it is particularly critical to understand the fine temporal patterns of depression during a lockdown so as to better inform subsequent mental health services. The alarming trend of depression in our results necessitates early psychological interventions even within the first couple of days during a lockdown. Ahrens et al.[16] samples people's psychological resilience once a week in the Rhine-Main region since the major lockdown started on March 22, 2021 in Germany. In contrast, our study here directly measures the severity of depression symptoms, offering direct evidence for the fast evolution of psychopathology.

Our results are also of value to governors who make lockdown decisions. Lockdowns are effective but costly, because it inevitably alters almost every sector of society. A rational lockdown decision should be based on careful weighing of benefits and loss induced by a lockdown[17]. The situation of 25 million residents suffering a lockdown also creates a unique research opportunity to study the psychological consequences. China perhaps implements the strictest lockdown policies in the world. As the latest Covid-19 variant—Omicron—exhibits a lower fatality rate and a stronger transmission ability, the challenge persists with respect to how to consider the deeper influences of a lockdown. Our results of the rapid increase in depression during the initial phase of a lockdown offer a new perspective on psychological interventions in future lockdown decisions.

In summary, our study highlights the fast evolution of depression even in the first few days during a lockdown. These concerning findings call for special attention on early psychological interventions as critical medical services during society lockdowns.

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AUTHOR CONTRIBUTION

W.L. conceived and supervised the project; S.Z., M. S., and Mr. Xiangyu Yang contributed more in data collection; X.M, X.H, L.W and R.-Y.Z. analyzed data; R.-Y.Z. and X.M. wrote the first draft; all authors contributed to collect data, review and edit the manuscript.

CONFLICT OF INTEREST

The authors declare no competing financial interests.

REFERENCES

1. World Health O. Mental health and psychosocial considerations during the COVID-19 outbreak, 18 March 2020.). World Health Organization (2020).

2. Xiang Y-T*, et al.* Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. *The Lancet Psychiatry* **7**, 228-229 (2020).

3. Li W*, et al.* Mental Health of Young Physicians in China During the Novel Coronavirus Disease 2019 Outbreak. *JAMA Network Open* **3**, e2010705 (2020).

4. Zhou J, Liu L, Xue P, Yang X, Tang X. Mental health response to the COVID-19 outbreak in China. *American Journal of Psychiatry* **177**, appi.ajp.2020.2022 (2020).

5. Rossi R*, et al.* COVID-19 Pandemic and Lockdown Measures Impact on Mental Health Among the General Population in Italy. *Frontiers in Psychiatry* **11**, (2020).

4126. Ahrens K*, et al.* Differential impact of COVID-related lockdown on mental health in
413 Germany. *World Psychiatry* **20**, 140-141 (2021).
414
4157. Elmer T, Mepham K, Stadtfeld C. Students under lockdown: Comparisons of students'
416 social networks and mental health before and during the COVID-19 crisis in Switzerland.
417 *PLOS ONE* **15**, e0236337 (2020).
418
4198. Pieh C, Budimir S, Delgadillo J, Barkham M, Fontaine JRJ, Probst T. Mental Health
420 During COVID-19 Lockdown in the United Kingdom. *Psychosomatic Medicine* **83**,
421 (2021).
422
4239. Panchal U*, et al.* The impact of COVID-19 lockdown on child and adolescent mental
424 health: systematic review. *European Child & Adolescent Psychiatry*, 1-27 (2021).
425
42610. Kim S, Sloan C, Montejano A, Quiban C. Impacts of Coping Mechanisms on Nursing
427 Students' Mental Health during COVID-19 Lockdown: A Cross-Sectional Survey.
428 *Nursing Reports* **11**, 36-44 (2021).
429
43011. Ckk A, Mep A, Dpvm A, Evkp A, Kkkp A, Knf B. University students' mental health
431 amidst the COVID-19 quarantine in Greece. *Psychiatry Research* **290**.
432
43312. Luo M, Guo L, Yu M, Wang H. The Psychological and Mental Impact of Coronavirus
434 Disease 2019 (COVID-19) on Medical Staff and General Public – A Systematic Review
435 and Meta-analysis. *Psychiatry Research* **291**, 113190 (2020).
436
43713. Kaparounaki CK, Patsali ME, Mousa D-PV, Papadopoulou EVK, Papadopoulou KKK,
438 Fountoulakis KN. University students' mental health amidst the COVID-19 quarantine in
439 Greece. *Psychiatry Research* **290**, 113111 (2020).
440
44114. Banks J, Xu X. The Mental Health Effects of the First Two Months of Lockdown during
442 the COVID-19 Pandemic in the UK *. *Fiscal Studies* **41**, 685-708 (2020).
443
44415. Beck AT, Steer RA, Brown GK. Manual for the Beck depression inventory-II. San
445 Antonio. *TX Psychol Corp*, 1-82 (1996).
446
44716. Berger L*, et al.* Rational Policymaking during a Pandemic. *Proceedings of the National*
448 *Academy of Sciences* **118**, e2012704118 (2021).
449
450